MONITORING & REPORTING PROGRAM PLAN

Goose Lake Agricultural Water Quality Program

SWRCB Agreement 05-070-555-0

In Accordance With:

Monitoring and Reporting Program Order No. R5-2008-0005
for Coalition Groups under Resolution No. R5-2006-0053,
Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands

Plan Prepared By:

The Goose Lake Resource Conservation District
on behalf of the Goose Lake Coalition

Address correspondence to:

Julie Laird, GLRCD
P.O. Box 20
Plush, OR 97637
julielaird@wildblue.net
541-947-3868

Herb Jasper, GLRCD
P.O. Box 212
New Pine Creek, OR 97635
jasperranch@centurytel.net
530-946-4196

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1. INTRODUCTION

The Goose Lake Coalition (Coalition) has prepared this Monitoring and Reporting Program Plan (MRPP) according to Monitoring and Reporting Program Order No. R5-2008-0005 (MRP) for Coalition Groups under the Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands Order No. R5-2006-0053. This plan documents our strategy to monitor ambient stream water quality and quantity below irrigated agriculture production activities within the California portion of the Goose Lake Basin Watershed. This monitoring strategy is designed to document any effects on stream water quality attributable to irrigated agriculture.

The overall objective of this program is to fulfill the requirements of the Irrigated Lands Regulatory Program (ILRP) and the Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands and to proactively address water quality issues associated with discharge from irrigated lands in this area. The data collected through this plan will continue to provide information for the identification of areas in need of improved management practices to protect water quality as well as the future evaluation of water quality improvement resulting from the implementation of strategic management practices where impairments are identified.

1.1 Description of the area / watershed

The Goose Lake Basin watershed stretches across the border between northeastern California and south-central Oregon, as shown in Figure 1. The high desert watershed encompasses 1,140 square miles of land that drains from both the west and the east into Goose Lake, a closed-basin lake system that no longer has a surface outlet to the nearby Pit River. The last recorded lake overflow occurred in 1868, when after a series of extremely wet years, the lake did contribute some surface flow into the Pit River System. Currently, a low, gravelly terrace separates the lake from a marshy meadow. Elevations within the watershed range from 8,000 feet in the Warner Mountains on the east side of the basin down to 4,693 feet at average lake level. Vegetation is diverse and ranges from mixed conifer forests in the Warner Mountains to sagebrush-dominated shrublands, grasslands, and marshes descending from the mountains towards the lake.

Figure 1. Location of the Goose Lake Basin.

Climate: The climate of the Goose Lake Basin is typical of a high-altitude desert region, with warm dry summers and cold wet winters. The annual precipitation throughout the basin typically ranges between 15 and 20 inches, much of it occurring as snow. As described below, the area usually experiences four distinct seasons throughout the year.

The heart of the winter season in the Goose Lake Basin occurs from December through February (when the coldest temperatures and the most snow occurs), though it is common to have snow flurries anytime from October through May, or even later. Within the 90-day period between the beginning of December and the end of February, the number of days with lows below freezing averages approximately 82, with lows below zero on 6.4 days. The amount of snow received each year is highly variable, however, as shown by data from the Alturas Ranger Station. Between 1931 and 2006, the station determined mean annual precipitation to be 12.5 inches, with a low of 6.54 inches in 1976 and a high of 20.9 inches in 1998. Though the station is located just outside of the Goose Lake Basin, the data reflects the same type of annual variability in precipitation experienced within the Coalition area.

Spring in the Goose Lake Basin is generally considered to include the months of March, April, and May. Data from the Alturas Ranger Station shows that Modoc County has a mean of 3.77 inches of precipitation during the spring season. Light, quick-melting snowfalls are common, with about 59 potential days of frost during these months.

The months of June, July, and August comprise summer in the Basin, though daytime temperatures can turn hot as early as mid-May. Highs in the 80s and 90s during the day are common throughout the summer, with occasional spikes into triple digit temperatures. Summer low temperatures tend to be around 50 to 60 degrees at night. Low humidity and occasional thunderstorms also characterize the summer season. Despite the thunderstorms, precipitation is scarce during these months. Recent climate data has recorded only 0.2 inches out of the 15-20 inches of annual precipitation during this season.

Lastly, the fall season in the Goose Lake Basin lasts from September through November. Nighttime temperatures usually start dropping dramatically in October, though some of the season's first severe frosts often occur in September. Precipitation increases again during the fall with rain and rain-snow mixes possible throughout these months.

Major waterbodies and tributaries: Most of the significant perennial tributary creeks within the California portion of the basin flow westward out of the Warner Mountains toward Goose Lake which itself covers thirteen percent of the entire area of the basin. Within California, Lassen and Willow creeks are the major water bodies that flow into Goose Lake. Though much of Pine Creek flows on the California side of the state line, the creek actually enters Goose Lake on the Oregon side of the basin. Six additional creeks (Cottonwood, Barnes, Davis, Roberts, Linnville, and Franklin) never reach the lake but instead end in terminal pastures. These creeks and their tributaries are important for aquatic habitat benefits and aesthetic quality, in addition to contributing to local supplies for agricultural uses.

Lassen and Willow creeks in particular provide critical cold-water habitat for trout, as well as other native fish and invertebrates. Four of these native fish species occur only in the Goose Lake Basin. They include: the Goose Lake redband trout (*Oncorynchus mykiss*), Goose Lake sucker (*Catostomus occidentalis lacusauserinus*), Goose Lake tui chub (*Gila bicolor thalassina*), and Goose Lake lamprey (*Lampetra tridentata*). Though these species spend much of their adult lives in Goose Lake, they rely on Lassen and Willow creeks for their spawning and rearing habitat. During periods of prolonged drought when Goose Lake goes dry, these creeks also provide emergency refuge for these and other aquatic species.

Water quality impairment listings and identified beneficial uses: Currently, the State Water Resources Control Board (SWRCB) has not identified any of the waterbodies within the California portion of the Goose Lake Basin as impaired under Section 303(d) of the federal Clean Water Act (CWA). The Central Valley Regional Water Quality Control Board (CVRWQCB) Basin Plan for the Sacramento River Basin has, however, set some waterbody specific limits for Goose Lake itself. According to that plan, the pH of Goose Lake must be in the range of 7.5-9.5 units at all times, and total dissolved solids (TDS) cannot exceed 1,300,000 tons. These limits help to determine the magnitude of any impact from irrigated agriculture discharges.

Goose Lake itself has been deemed to have several beneficial uses, which include irrigation, stock watering, contact recreation, noncontact recreation (other than canoeing and rafting), warm freshwater habitat, cold freshwater habitat, and wildlife habitat. Water quality conditions, as determined through this monitoring effort, will be evaluated to determine if they are protective of these uses.

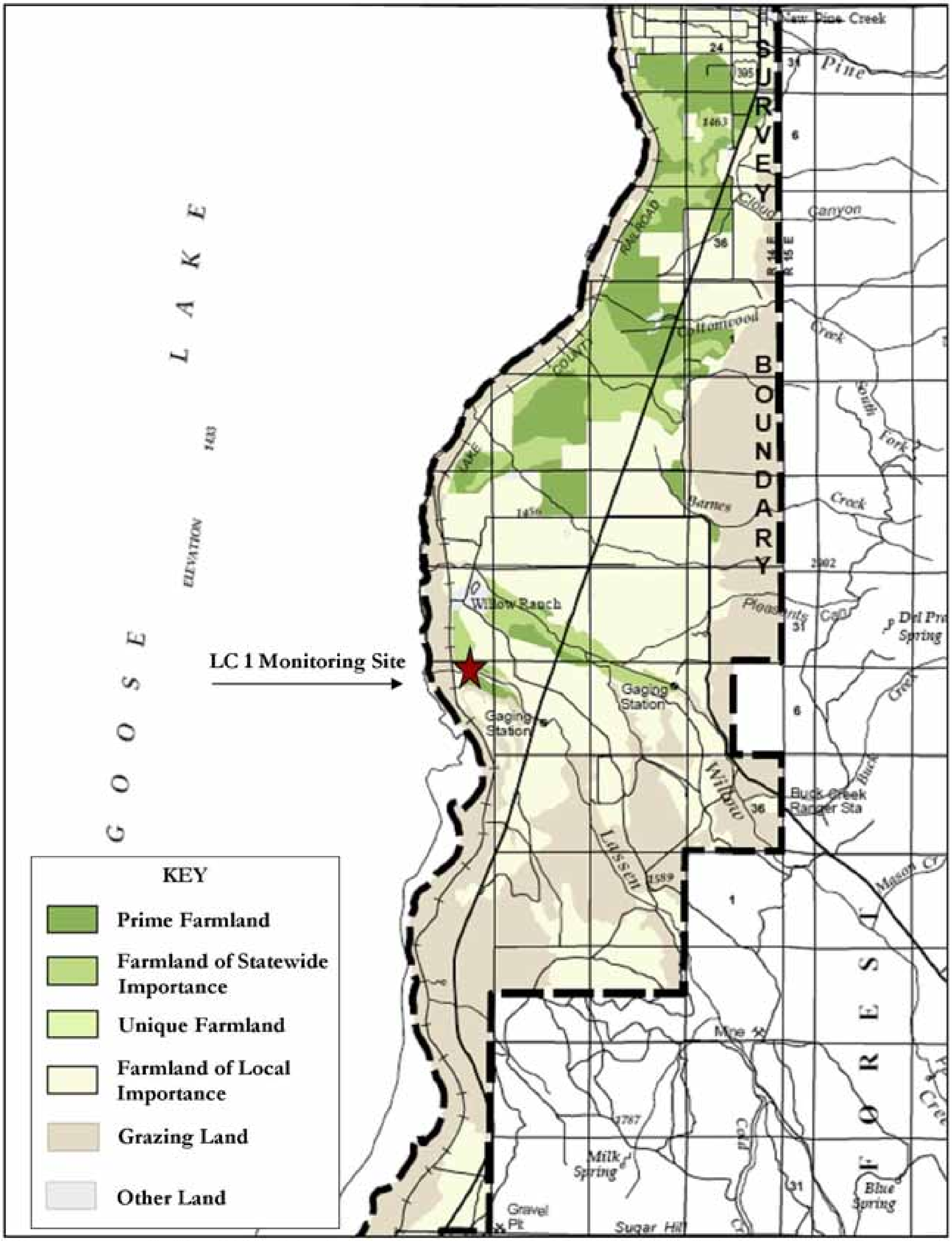
1.2 Summary of Land Use & Agricultural Practices

Coalition area: The Goose Lake Coalition encompasses the irrigated agricultural lands within the California portion of the Goose Lake Basin. The northern boundary of the Coalition's area is at the town of New Pine Creek on the Oregon-California border, with the southern boundary falling approximately 7 miles south of the town of Davis Creek (a total distance of approximately 23 miles, north to south). All of the irrigated lands on the California side of the Basin occur on the east side of Goose Lake, occupying the area that lies between the Lake and the Warner Mountains. Figures 2 and 3 on the following pages show the irrigated lands, waterbodies, and monitoring sites within the Coalition's boundaries. For the specific crop types and irrigation practices associated with each major waterbody, please refer to Table 1.

Land use and crop types: Land use throughout the Goose Lake Basin has changed little over the last 70 years, with approximately 50 percent of the watershed being privately owned. These private lands are used predominately for livestock grazing, but are also important for both irrigated and dryland hay production. Major crops types include alfalfa hay, orchardgrass hay, native meadow hay, and irrigated pasture. Common annual dryland crops include cereal rye, triticale, and oats for hay.

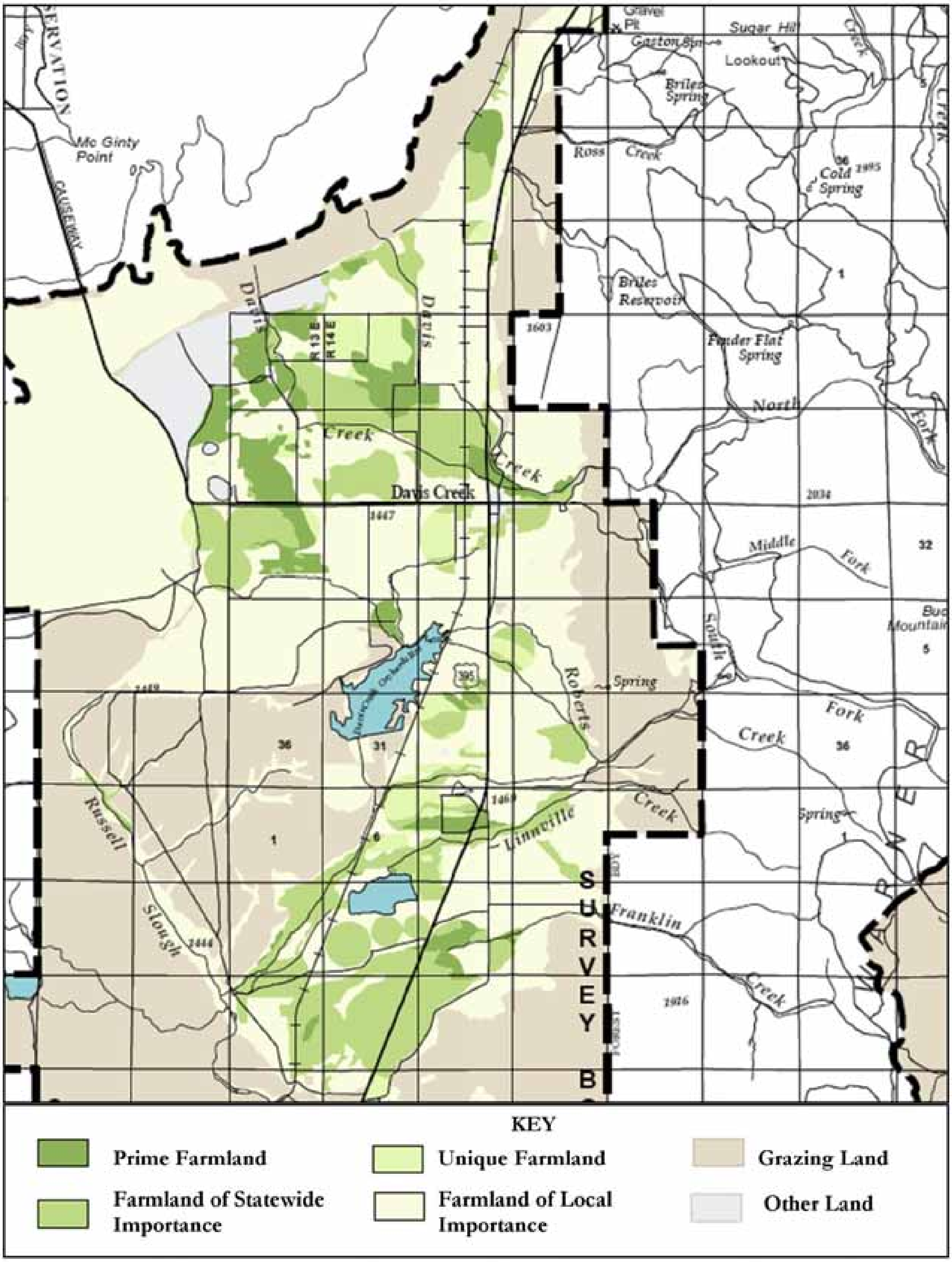
The remainder of the land within the Basin is publicly owned and is predominately managed by the U.S. Forest Service and the Bureau of Land Management (BLM). These public lands are managed for multiple-use with livestock grazing and dispersed recreation being two of the most predominant uses. Minimal timber harvest takes place, usually for purposes of vegetation management for fire protection.

Figure 2. North end of the Goose Lake Coalition area, showing irrigated lands, major waterbodies, and the Coalition's primary monitoring site for this MRPP.



Base map source: California Department of Conservation, Division of Land Resource Protection, Farmland Mapping and Monitoring Program, 2008. www.conservation.ca.gov

Figure 3. South end of the Goose Lake Coalition area, showing irrigated lands and major waterbodies.



Base map source: California Department of Conservation, Division of Land Resource Protection, Farmland Mapping and Monitoring Program, 2008. www.conservation.ca.gov

Descriptions of Land Categories from Maps: The land categories shown in Figures 2 and 3 were developed by the California Department of Conservation, Division of Land Resource Protection, Farmland Mapping and Monitoring Program (FMMP). To create the maps, FMMP combines current land use information with U.S. Department of Agriculture—Natural Resources Conservation Service (NRCS) soil survey data. Following is FMMP's descriptions of each land type as shown on the maps:

- Prime Farmland: Prime Farmland has the best combination of physical and chemical features able to sustain long-term agricultural production. This land has the soil quality, growing season, and moisture supply needed to produce sustained high yields. Land must have been used for irrigated agricultural production at some time during the four years prior to the mapping date.
- Farmland of Statewide Importance: Farmland of statewide importance is similar to prime farmland but with minor shortcomings, such as greater slopes or less ability to store soil moisture. Land must have been used for irrigated agricultural production at some time during the four years prior to the mapping date.
- Unique Farmland: Unique farmland consists of lesser quality soils used for the production of the state's leading agricultural crops. This land is usually irrigated, but may include non-irrigated orchards or vineyards as found in some climatic zones in California. Land must have been cropped at some time during the four years prior to the mapping date.
- Farmland of Local Importance: Irrigated and dry cropland classified as Class III and Class IV irrigated land if water is or becomes available. Based on NRCS definitions, Class III soils are those with severe limitations that reduce the choice of plants or require special conservation practices, or both. Class IV soils have very severe limitations that restrict the choice of plants or require very careful management, or both.
- Grazing Land: Grazing land is land on which the existing vegetation is suited to the grazing of livestock.
- Other Land: Other land is land not included in any other mapping category. Common examples include low density rural developments, brush, timber, wetland, and riparian areas not suitable for livestock grazing, confined livestock, poultry, or aquaculture facilities, strip mines, borrow pits, and water bodies smaller than 40 acres. Vacant and nonagricultural land surrounded on all sides by urban development and greater than 40 acres is mapped as other land.

Irrigation practices: Within the California portion of the Goose Lake Basin, less than four percent of the land area is cultivated, with approximately 9,000 acres involved in irrigated agriculture production. Center-pivot, wheel-line sprinklers and controlled flooding are the current irrigation practices used within the watershed.

The Basin's center-pivot and wheel-line sprinklers utilize groundwater from underground aquifers. They are low-pressure systems that do not generate runoff due to the management practices employed for these irrigation methods. Growers closely monitor irrigation water application rates to ensure adequate moisture for their crops, while also managing the timing of their irrigation so that all parts of their fields are watered evenly and consistently. Managers seek to apply just enough water to a given area to meet plant requirements until the sprinklers rotate back to that portion of the field. Given the high costs of electricity to pump groundwater for irrigation, growers ensure that no excess water is applied beyond what their crops can use.

In contrast to irrigation by center-pivot or wheel-line sprinkler systems, the controlled flood irrigation systems within the Basin rely on surface diversions of water from creeks as they flow out of the Warner Mountains. Previous research has shown that as much as 78% of the flow of Willow Creek and 63% of Lassen Creek can be diverted during the peak of the irrigation season (Tate et al. 2005c). Diverted water is carried by earthen delivery ditches and is then distributed out of the ditches by the use of tarp dams. The irrigation water then flows across the fields by gravity until it collects in return flow ditches and swales or infiltrates to become subsurface flow. In order to distribute the water across the fields, it is common for the tarp dams to be moved 2-3 times during the irrigation season.

As described in Table 1, irrigated agriculture through flood irrigation takes place principally within the Willow Creek and Lassen Creek subwatersheds. Groundwater is not utilized for irrigation within these two drainages. Other significant irrigated lands (with some flood irrigation but also with significant dependence on groundwater resources) are located within the Pine Creek, Cottonwood Creek, Barnes Creek, Davis Creek, Roberts Creek, Linnville Creek, and Franklin Creek subwatersheds.

Table 1. Crops, agriculture uses, and irrigation practices by sub-watershed within the boundaries of the Goose Lake Coalition.

Waterbody	Crops/Agriculture Uses	Types of Irrigation	Sources of Irrigation Water	Fate of Tailwater
Pine Creek (Note: Confluence of Pine Creek with Goose Lake is on Oregon side of the state line)	• Alfalfa hay • Grazing • Winter livestock feeding areas • Commercial wild plum orchard	Low pressure wheel-lines and center-pivots; Flood	Groundwater; Surface water diversions from Pine Creek	No returns to creek. Tailwater from flood irrigation infiltrates into terminal pastures.
Cottonwood Creek	• Alfalfa hay • Grazing	Low pressure wheel-lines and center-pivots	Groundwater	No tailwater generated by low pressure systems.
Barnes Creek	• Alfalfa hay • Grazing	Low pressure wheel-lines and center-pivots	Groundwater	No tailwater generated by low pressure systems.
Willow Creek	• Native meadow hay • Grazing • Winter livestock feeding areas	Flood	Surface water diversions from Willow Creek	Returns to creek as surface runoff in ditches and shallow swales as well as subsurface flow.

Waterbody	Crops/Agriculture Uses	Types of Irrigation	Sources of Irrigation Water	Fate of Tailwater
Lassen Creek	• Native meadow hay • Grazing • Winter livestock feeding areas	Flood	Surface water diversions from Lassen Creek	Returns to creek as surface runoff in ditches and shallow swales as well as subsurface flow. Majority ends in terminal pastures.
Davis Creek	• Alfalfa hay • Orchardgrass hay • Grazing • Winter livestock feeding areas • Non-commercial apple orchard	Low pressure wheel-lines and center-pivots; Flood	Groundwater; Surface water diversions from Davis Creek	No returns to creek. Tailwater from flood irrigation infiltrates into terminal pastures.
Roberts Creek	• Alfalfa hay • Orchardgrass hay • Grazing • Winter livestock feeding areas	Low pressure wheel-lines and center-pivots;	Groundwater	No tailwater generated by low pressure systems.
Linnville Creek	• Alfalfa hay • Orchardgrass hay • Grazing • Winter livestock feeding areas	Low pressure wheel-lines and center-pivots;	Groundwater	No tailwater generated by low pressure systems.
Franklin Creek	• Orchardgrass hay • Grazing • Winter livestock feeding areas	Low pressure wheel-lines and center-pivots;	Groundwater	No tailwater generated by low pressure systems.

Several small reservoirs exist throughout the Goose Lake Basin which serve to capture and store spring snowmelt water. When stream flows stop or become too low later in the irrigation season, reservoir water is utilized to supplement irrigation supplies.

Grazing practices: Livestock production is a major part of the agriculture in the Goose Lake Basin, and is thus intertwined with all other agriculture activities within the area. For instance, much of the hay produced within the Basin is fed locally to sustain resident cattle through the winter season when snow covers the often frozen ground. Similarly, in late summer and early fall, once hay crops have been harvested, cattle often graze on the aftermath (i.e. residual plant material remaining after haying is complete) within the fields. Unlike some regions in California where the majority of cattle are present during specific seasons of the year only (such as the annual rangelands of the

Central Valley where cattle graze the available forage from late fall through early spring), the Goose Lake Basin maintains fairly steady numbers of livestock throughout the year. Only a few operations within the California side of the Basin ship cow/calf pairs or stocker cattle into the area for the summer grazing season and then move them out again during the time of the year when the native forages are dormant or unavailable.

Goose Lake Basin ranchers have developed a series of grazing management practices to optimize both forage and livestock production while also being protective of water quality and rangeland health. Long-standing partnerships between the Basin's ranchers and the University of California Cooperative Extension (UCCE) Farm Advisors as well as the NRCS have led to the development and implementation of a series of grazing BMPs as described below.

Achieving uniform livestock distribution and utilization across pastures is a major goal of ranchers and range managers alike. While uneven grazing causes negative impacts from both the over- and under-utilization of resources, uniform grazing distribution has positive impacts on both the current and potential grazing capacity of the range and on the overall health of the land (Laca 1998, Owens et al. 1991). One of the major challenges in achieving uniform grazing distribution is created by the well-documented preference of cattle for riparian meadows (Kauffman and Krueger 1984). Research and local experience have both confirmed that without management controls in place, cattle tend to concentrate in riparian areas, especially during late summer, causing a disproportionate amount of use in these critical zones when compared to the surrounding uplands (Roath and Krueger 1982). With management controls in place, however, livestock distribution can be altered in ways that stream banks and water quality are both protected and enhanced.

One of the management practices common in the Goose Lake Basin is the use of rotational grazing through a series of pastures and/or fields. Ranchers manage not only the duration that their animals are in a particular field, but also the timing of when particular areas are grazed. Rotational grazing systems help ensure that proper utilization levels are achieved, that adequate periods of rest are provided so that the vegetation remains vigorous and productive, and that grazing pressure on sensitive areas such as riparian zones can be managed in a way that protects their health and the resulting water quality. For instance, through the use of a rotational grazing system, it is common for a particular pasture or field to be utilized at different times over a series of years. A pasture that is utilized early in the spring but rested for the remainder of the growing season has the opportunity for the vegetation to re-grow and maintain healthy root systems that will carry the plants through the winter and prepare them for use the following year. In a rotational grazing system, that same pasture may be utilized late in the summer the following year, thus allowing the vegetation to complete its growth cycle, produce seed, and even go dormant before being utilized again by livestock. By maintaining vigorous plant communities, especially near riparian areas, excessive sedimentation and erosion can be reduced, as stream banks remain stable and the riparian area functions properly.

In conjunction with rotational grazing, fences are another important tool utilized by ranchers to help control livestock distribution and reduce animal impact on riparian areas. Though fences are sometimes thought of as tools to exclude cattle from using riparian area vegetation, they have also been shown to be highly effective in altering animal distribution and for creating rotational grazing systems as described above, while still allowing controlled livestock use of the riparian zone (Bailey and Rittenhouse 1989, Kauffman and Krueger 1984). Goose Lake Basin ranchers have and continue to seek opportunities to utilize fences to manage livestock access to streams.

Lastly, another important tool utilized within the Basin to help improve livestock distribution and reduce pressure on riparian areas is the use of offstream water sources. Since watering areas tend to be the centers of grazing activity, improving water supplies around a pasture can open new areas to grazing and simultaneously reduce pressure on riparian areas. Ranchers in the Goose Lake Basin utilize a variety of offstream water sources, including small reservoirs and developed springs flowing into water troughs. Offstream water sources are often utilized in combination with rotational grazing systems and strategic fencing. The combination of these BMPs has proved to be highly effective in protecting riparian function and the resulting water quality within the Basin.

Meadow management practices: One of the common management practices within the Goose Lake Basin is the dragging of meadows and other livestock winter feeding grounds. As described above, cattle often graze the aftermath of haying in the late summer and early fall. Hay fields and meadows are also often used to feed hay to resident cattle throughout the winter season. Accordingly, in the spring, before irrigation begins, growers drag these areas to help break up and distribute the fecal pats left by the cattle, which act as a natural source of fertilizer and organic matter. A variety of devices are used as drags, but they usually involve some type of chain or metal bar pulled by a tractor or pickup truck. Because the drag rides along the surface of the existing vegetation, no soil is disturbed through this process.

Farming practices: Annual tillage of land within the Goose Lake Basin is minimal, as native meadow fields are never tilled, and alfalfa and orchardgrass stands usually last over 10 years before they are replanted. The scenario where tillage is used most often is in the production of annual dryland crops such as cereal rye, triticale, and oats for hay. When land is tilled for establishing new crops, the standard practice is to begin by lightly discing the field and then following that with a drag or an implement known as a cultipacker. The cultipacker is used to essentially roll over the field after the final discing to ensure a firm seedbed, thus maximizing the soil to seed contact. Once the seedbed is established, growers then drill in the seed. For dryland crops, planting occurs in March or April and harvest is usually in July.

Fertilizer use: Given the crop types, growing conditions, and climate of the Basin, fertilizers are rarely applied. The average growing season within the Basin is approximately 90 days. Research by UCCE has shown that crops in this area must be under season-long irrigation (i.e. irrigation that lasts the duration of the growing season) in order for growers to reach a high enough level of production to recoup the costs of any fertilizers applied. The only growers that can depend on enough water to irrigate through the duration of the growing season are those that are using wells to pump from underground aquifers. In contrast, growers that divert stream water for irrigation (as is the case in the Lassen Creek and Willow Creek watersheds) may have anywhere from only a few weeks to almost three months to irrigate each summer, depending on the amount of snow accumulation in the upper watershed. In drought years, growers relying on surface water diversions cannot depend on having adequate water throughout the growing season and thus cannot justify the costs of fertilizer application.

The most common scenario when fertilizer is used in the Goose Lake Basin is in the production of orchardgrass hay that is under season-long irrigation from groundwater sources. These growers typically apply between 100-200 units of nitrogen per acre per season. Growers usually apply the fertilizer through a series of applications, with the first occurring just after growth begins in the spring (around April or May), and the second taking place after the first harvest of hay towards the end of June (if the grower is trying for a second cutting later in the summer).

Orchard management practices: As shown in Table 1, there are a few small orchards within the California portion of the Goose Lake Basin. Near New Pine Creek, there is a commercial wild plum orchard that comprises less than 20 acres. Just north of Davis Creek, there are two apple orchards that are less than 10 acres each. The apple orchards are not irrigated, and commercial production ceased in 2003. All of these orchards combined represent a miniscule portion of the Basin as a whole. They are managed with minimal inputs (in contrast to the intensively managed, high producing orchards common in the Central Valley). Cover crops are present underneath the tree canopies so that the majority of the ground surface is vegetated instead of being bare ground.

The commercial wild plum orchard has utilized organic production practices for the past five years. To date, the grower has not had to use any pesticides, but if a scenario did arise where chemicals were needed (e.g. an insect or fungus problem), he would use only organically certified products. Any storm runoff from the plum orchard is absorbed by the alfalfa and grass fields below it, thus eliminating the possibility of the runoff reaching any waterbody.

The agricultural practices described above and the time of year that they take place are summarized in Table 2. Of the approximate 9,000 irrigated acres within the Goose Lake Basin, nearly 3,000 of them are hayed in any given year. Similarly, approximately 6,000 of the irrigated acres are grazed each year. For dryland crops, less than 1,000 acres are hayed annually.

Table 2. Annual timeline of agricultural activities occurring in the Goose Lake Basin.

Month	Weather/Conditions	Agricultural Practices
January	Snow and frozen ground	Resident cattle fed hay on meadows and dry land feed grounds. No dormant season sprays, tillage, or other agriculture practices.
February	Snow and frozen ground	Resident cattle fed hay on meadows and dry land feed grounds. No dormant season sprays, tillage, or other agriculture practices.
March	Snow and frozen ground	Resident cattle fed hay on meadows and dry land feed grounds. No dormant season sprays, tillage, or other agriculture practices.
April	Snow usually melted; spring snow and rain events common; some irrigation begins	Depending on the snowpack and weather conditions each year, diversions for surface water irrigation usually installed, with flood irrigation season beginning towards the middle or end of the month. Pumping of groundwater for irrigation begins. Limited tillage begins for annual dry land hay crops. Dragging of meadows is completed. Depending on forage availability, some stocker cattle and cow/calf pairs start to be shipped into the basin from annual rangelands in California.
May	Spring storms; growing season begins; irrigation	Irrigation from surface water diversions and ground water pumping in full swing. Major shipping of non-resident cattle into the basin from annual rangelands. Resident cattle mostly on meadows and dryland pastures.
June	Growing season; irrigation	Irrigation from surface water diversions and ground water pumping continue. First harvest of alfalfa and orchardgrass hay crops. Non-resident cattle on irrigated pastures and meadows. Resident cattle turned out on USFS and BLM public land grazing allotments.

Month	Weather/Conditions	Agricultural Practices
July	Growing season; irrigation	Irrigation from surface water diversions usually ends due to lack of stream flow. Irrigation from ground water sources continues. Meadow hay and dry land hay crops harvested.
August	Growing season; irrigation from groundwater only	Irrigation from ground water sources continues. Second harvest of alfalfa and orchardgrass hay crops. Non-resident cattle continue on irrigated pastures and meadows. Resident cattle turned out on USFS and BLM public land grazing allotments.
September	First severe frosts	Irrigation from ground water sources ends. Final harvest of alfalfa hay that has been under season-long irrigation from ground water sources. Some non-resident cattle shipped out of basin back to annual rangelands. Resident cattle gathered from public land allotments and return home to meadows and hay fields to graze haying aftermath.
October	Killing frosts; growing season ended	Limited fall tillage to prepare ground for spring planting of dry land hay crops. More non-resident cattle shipped out of the basin. Resident cattle grazing on meadow and hay field aftermath.
November	Snow/rain storms	All non-resident cattle shipped out. Resident cattle grazing on meadow and hay field aftermath. Some hay fed as supplemental feed.
December	Snow and frozen ground	Resident cattle fed hay on meadows and dry land feed grounds. No dormant season sprays, tillage, or other agriculture practices.

Pesticide use: Within the Goose Lake Basin, there is extremely limited agricultural use of herbicides or pesticides, as reflected in the annual pesticide use reports published by the Department of Pesticide Regulation (DPR) available at http://www.cd.pr.ca.gov. Table 3 summarizes the pesticides applied in the Goose Lake Basin from 2000-2007, based on the information available through DPR's Pesticide Use Database (CalPIP 2008) and the Modoc County Agricultural Commissioner.

Information from the Modoc County Agricultural Commissioner supports the pesticide use trends for the Goose Lake Basin shown in Table 3. As part of the Coalition's Semi-Annual Monitoring Reports (SAMRs) in June and December 2007, the Commissioner reported that no landowners within the California portion of the Goose Lake Basin had applied for a pesticide use permit from November 1, 2006 through October 30, 2007. Thus, because no one applied for a permit, there were no reports of pesticide use during that time frame. The Agricultural Commissioner confirmed that pesticide use within the Basin has traditionally been very minimal. The Commissioner's reports to the Coalition are included with the SAMRs as appendices.

In summary, based on the review of DPR's Pesticide Use Database (CalPIP 2008) and the consultation with the Agricultural Commissioner, no pesticides have been applied within the California portion of the Goose Lake Basin since 2003. As seen in Table 3, when chemicals do need to be utilized, however, Basin growers do report them.

Table 3. Pesticide use data for the Goose Lake Basin from 2000-2007. Data from the Department of Pesticide Regulation (DPR) -- http://www.cd.pr.ca.gov.

[redacted]

Grower outreach: As mentioned above, growers in the Goose Lake Basin have a long history of working with entities such as the UCCE Farm Advisor's Office, the NRCS, and other agencies to stay current on conservation issues and best management practices, as well as to find ways to work together to improve watershed conditions. The UCCE Farm Advisors, based out of Alturas, have helped to conduct applied research within the Basin to address on-the-ground resource and management issues, as described in more detail in Section II of this plan. The Farm Advisors have also helped bring the expertise of on-campus specialists and researchers to the Basin to work with growers and share information from their research and experience around the state. Additionally, the local NRCS Field Office in Alturas has and continues to provide technical expertise and ideas for implementing BMP and other conservation projects throughout the Basin. Goose Lake growers have worked with NRCS technicians to implement projects such as offstream water development for livestock, strategic fencing, irrigation efficiency enhancement, and more.

Further, since the formation of the Goose Lake Coalition to meet the requirements of the ILRP, the Coalition itself has also been a source of grower outreach not only to keep producers up to date regarding program and regulatory requirements but also to provide a series of workshops to present information related to BMPs for irrigation and land management in general. The Coalition utilizes both local and state-wide expertise to help Basin growers stay current and aware of effective, proven management practices and the technical resources available to them.

1.3 Description of Watershed Partnerships within the Goose Lake Basin

Goose Lake Fishes Working Group & Watershed Council: Within the Goose Lake Basin, there is a long history of bi-state collaboration between private landowners and agency personnel dating back to the early 1990's, when all four of the unique native fish species of the Goose Lake Basin were proposed for listing under the federal Endangered Species Act (ESA). A period of extended drought had resulted in Goose Lake going dry in 1992, and concerns rose over the potential impacts to the resident fish. In response, private landowners, agencies, and conservation groups came together to form the Goose Lake Fishes Working Group. The group agreed to voluntarily monitor existing fish population levels and complete a bi-state Goose Lake Fishes Conservation Strategy that outlined how basin stakeholders would help protect the native fishes by enhancing water quality and aquatic habitat. Based on the collaboration of landowners and agency representatives in developing the strategy, priority projects were identified and implemented on each of the major waterbodies in the basin. Due in large part to these efforts, the U.S. Fish and Wildlife Service (USFWS) decided in March of 2000 not to list the native Goose Lake Basin fishes on the Endangered Species List.

The original group that came together to develop the Conservation Strategy remains active today, and is now known as the Goose Lake Fishes Working Group and Watershed Council. The group continues to update the Conservation Strategy as priority watershed enhancement projects are completed and new opportunities to improve water quality and habitat on both sides of the state line are identified. As projects are implemented, the group often conducts field trips for members to see and discuss the results together. Through the development and continued execution of the Conservation Strategy, the stakeholders in the Goose Lake Basin have established high levels of communication and cooperation that will help ensure that the monitoring and reporting efforts described within this plan will be successful.

Goose Lake Resource Conservation District: One of the key members of the Goose Lake Fishes Working Group and Watershed Council on the California-side of the Basin is the Goose Lake Resource Conservation District (GLRCD). The GLRCD is the lead agency for the Goose Lake Coalition, administering all monitoring, reporting, and planning efforts. For several decades, the GLRCD has sought to help private landowners identify and implement BMPs to improve watershed health, water quality, and aquatic habitat. The RCD assists landowners in implementing projects by providing both financial assistance through the grants that the district has been awarded, and technical guidance often through the NRCS, members of the Fishes Working Group, and the UCCE system. The GLRCD has also collaborated with UCCE to conduct field research trials that provide management ideas and solutions tailored to the Basin's unique conditions and production types.

Through the efforts of the Coalition, the groups described above, and their partners, we have a substantial amount of information regarding the management practices being implemented within the Goose Lake Basin in order to address Program Question #4 as listed in the MRP Order. The existing knowledge base, and the continued collection of additional information through Coalition efforts, allows us to clearly document the management practices being implemented to reduce the impacts of irrigated agriculture on waters of the State as well as projects designed to enhance overall watershed health and condition.

II. PAST MONITORING SUMMARY

Significant monitoring has occurred in Goose Lake and its tributaries over the past two decades. Much of this has been applied research linking water quality to the effects of agriculture. As described below, these efforts have shown that there are not major water quality problems within the Basin. This has been confirmed by the Coalition's recent monitoring efforts under the ILRP as well as the macroinvertebrate analysis conducted by UC Davis researchers.

2.1 Physical Water-quality Parameter Monitoring

In 1993, a water quality monitoring program was initiated by Dennis Heiman of the Central Valley Regional Water Quality Control Board (CVRWQCB) to evaluate the existing condition of the major water bodies within the basin and thereby determine if any water quality parameters were at levels that would negatively impact aquatic life or other beneficial uses. This monitoring effort was conducted through 1998 in Lassen and Willow Creeks, the two major water bodies in the basin that receive irrigated agriculture return flows. The results showed that measured water quality parameters (including pH, conductivity, dissolved oxygen, nutrients, metals, and standard minerals) were generally at levels that would not adversely impact aquatic life or the other identified beneficial uses of the waters. While the monitoring showed that the water quality standards listed in the CVRWQCB's Basin Plan were not exceeded, it did reveal that water temperatures were elevated and that bacteria could possibly be a parameter of concern. Further, results from the metals analysis indicated that copper, lead, cadmium, and zinc are regularly detected in Lassen Creek water samples, though none of the metals concentrations were particularly high. Overall, no major water quality problems were detected. A copy of the complete summary report is included as Appendix A.

2.2 Intensive Stream Temperature Monitoring

Concerns over elevated temperatures in the tributary waters of the Goose Lake Basin prompted additional monitoring in the late 1990's, due to the proposed listing of all four native fish species unique to the basin under the federal ESA. Elevated stream temperatures were suggested as one of the main factors potentially impairing habitat in both Lassen and Willow Creeks.

Led by Dr. Ken Tate, Rangeland Watershed Specialist at UC Davis, an extensive monitoring project was implemented to establish a comprehensive data set portraying the heating and cooling patterns within the Lassen and Willow creek watersheds, while also identifying possible factors contributing to the observed temperatures and identifying areas where potential management changes could affect habitat conditions related to temperature. Stream temperature was recorded every half hour from June through September from 1999 through 2001 in Willow, Lassen, and Cold Creek. Air temperature, stream flow, canopy cover, and solar input were also measured and recorded to help fully interpret the stream temperature data. Two research articles summarizing the results of this research appeared in the *California Agriculture* Magazine in the July-September 2005 issue. Copies of these articles are included as Appendices B and C. Some of the conclusions that will be particularly useful in describing the existing conditions of these two creeks are summarized here.

One of the seasonal trends captured through the stream temperature monitoring efforts was that peak temperatures in Lassen and Willow creeks occur in July and August with rapid reductions occurring during the first week of September (Tate et al. 2005a). Further, Lassen and Willow creeks have summer stream flows that range from 1 to 5 cubic feet per second (cfs). Upon statistical analysis of the study data, streamflow was found to be highly correlated to water temperature so that for every cubic foot per second (cfs) increase in stream flow at a particular monitoring site, there was an estimated 1.64°F decrease in daily maximum stream temperature (Tate et al. 2005b). As summarized in the research, "Although both Lassen and Willow creeks gained heat through their lower reaches, which are associated with irrigation-water diversion and return, these lower reaches were not the sections of either creek with the highest temperature gains. This does not imply that irrigation management does not influence stream temperature, but rather that temperature gains in the middle and upper reaches must also be considered if reduced temperatures in the lower reaches are a habitat objective" (Tate et al. 2005a). In short, this extensive temperature study will continue to be valuable in helping to interpret the results of the monitoring program described in this plan.

2.3 Past Irrigated Agriculture Discharge Monitoring

A more recent monitoring effort undertaken in the Goose Lake Basin began as a result of the changing requirements for agricultural discharges in 2003. Recognizing that the previous irrigated agriculture discharge waiver granted by the CVRWQCB was being replaced by a new compliance process, the GLRCD and the UCCE service in Modoc County and at UC Davis realized the need to begin studying and trying to quantify the effects of irrigated agricultural discharges to the streams in the Goose Lake Basin.

As in previous research, these study efforts focused on Lassen and Willow creeks not only because of their importance in providing aquatic habitat for the basin's unique fish species, but also because they are the two streams on the California side of the basin that receive return flows from irrigated agriculture and also eventually reach Goose Lake. A research article summarizing the results of this study appeared in the July-September 2005 issue of *California Agriculture* Magazine and is included with this MRPP as Appendix D. Some of the most important conclusions are summarized below because of their usefulness in interpreting the results of the current monitoring program described in this plan.

The field work for this joint research project was conducted in 2003. Flow volume, electrical conductivity, turbidity, and dissolved oxygen were measured weekly during the irrigation season at each sampling location. In addition, approximately half of all the water samples were analyzed in a laboratory for total suspended solids, nitrate, ammonium, phosphate, sulfate, potassium, and dissolved organic carbon. The monitoring strategy allowed for: 1) the examination of in-stream water-quality changes due to irrigation, 2) the examination of changes in water quality as irrigation water passes through delivery ditches and moves across pastures, 3) an accounting for the differences in flow volume for each water source, and 4) an accounting for changes in water quality and flow over the 2-month irrigation season.

As a result of this intensive monitoring effort, it was determined that in-stream electrical conductivity was significantly higher below the irrigation systems in both Lassen and Willow creeks than above the diversions. Laboratory analysis indicated that this increase was due at least in part to increased concentrations of potassium and sulfate. The potassium and sulfate levels did not, however, represent significant water-quality problems. Analysis of samples from below irrigation also indicated that mineral nitrogen levels in these systems appeared to be low, with nitrate and ammonium levels being only slightly above the detection limits of 0.001 parts per million (ppm) and well below those of water-quality concern (such as the drinking water standard of 10 ppm and mineral nitrogen stream eutrophication levels of concern of 0.1 ppm). Sample analysis also revealed that levels of turbidity and total suspended solids were not significantly higher below than above the irrigation systems on both streams. The monitoring further revealed that the irrigated lands of both creek systems have the capacity to serve as sinks for solids such as sediment and organic matter contributed by source water and delivery ditches (Tate et al. 2005c). The results of the laboratory analyses are summarized in Table 4.

Table 4. Descriptive statistics for laboratory determined water quality variables across Lassen and Willow Creek study sites.

Water Source	Statistic	pH	DOC ppm	TSS mg/L	NO_3 ppm	NH_4 ppm	PO_4 ppm	K ppm	SO_4 ppm
Instream – Above irrigation	Mean	8.71	4.67	9.6	<0.001	0.006	0.010	2.64	0.18
n = 12	Max.	9.61	6.36	26.9	<0.001	0.096	0.157	4.83	0.34
Irrigation Delivery Ditch	Mean	8.97	5.23	15.4	0.001	0.002	0.064	1.83	0.17
n = 20	Max.	9.44	10.06	45.7	0.010	0.023	0.417	3.41	0.39
Irrigation/Pasture Runoff	Mean	8.62	6.47	10.0	0.003	0.000	0.14	1.26	0.10
n = 16	Max.	9.57	11.08	15.4	0.037	0.000	0.31	3.28	0.31
Instream – Below irrigation	Mean	8.65	5.34	11.0	0.001	0.000	0.077	3.38	1.34
n = 12	Max.	9.55	10.64	20.0	0.009	0.000	0.150	5.85	2.60

Overall, the intensive irrigation water quality study conducted on Lassen and Willow creeks in the summer of 2003 showed that while some water-quality impairment is associated with stream diversion and the flood irrigation system that presently exists, the impacts are relatively small and there are clear measures available to mitigate them.

2.4 Current ILRP Monitoring

The Coalition initiated their ILRP Phase 1 monitoring during spring 2007. The following discussion and tables summarize the results of the Coalition's 2007 ILRP monitoring.

Because of their importance as aquatic habitat, their ability to represent the dominant irrigated agricultural practices within the California side of the Goose Lake Basin, and because they receive surface irrigation return flows, Willow and Lassen creeks were the focal points of the Goose Lake Coalition's 2007 monitoring and reporting effort. Two primary sites were initially designated for the collection of water and sediment monitoring samples. These sites, known as WC 1 and LC 1, were selected because of their location below all irrigated agricultural areas on Willow Creek and Lassen Creek, as shown in Figure 4. Because of the *Ceriodaphnia dubia* (water flea) toxicity observed in Lassen Creek (see Table 6) during the 2007 irrigation monitoring season, the Coalition added new monitoring sites in the upper portions of the Lassen Creek watershed to find out more about where and why the toxicity occurs. Thus, Figure 4 also shows the two upper watershed sites (LC 2 and LC 3) added to our monitoring strategy later in the irrigation season.

Other than the *C. dubia* toxicity detected in Lassen Creek, the only other exceedance during the 2007 irrigation season was *E. coli* in Willow Creek during the 5/15/07 event, as shown in Table 5. As illustrated in Tables 5 and 6, no other water quality standards were exceeded, and no parameters were at risk of interfering with the beneficial uses of these waterbodies.

Figure 1. Goose Lake Coalition Monitoring Sites during the 2007 Irrigation Season

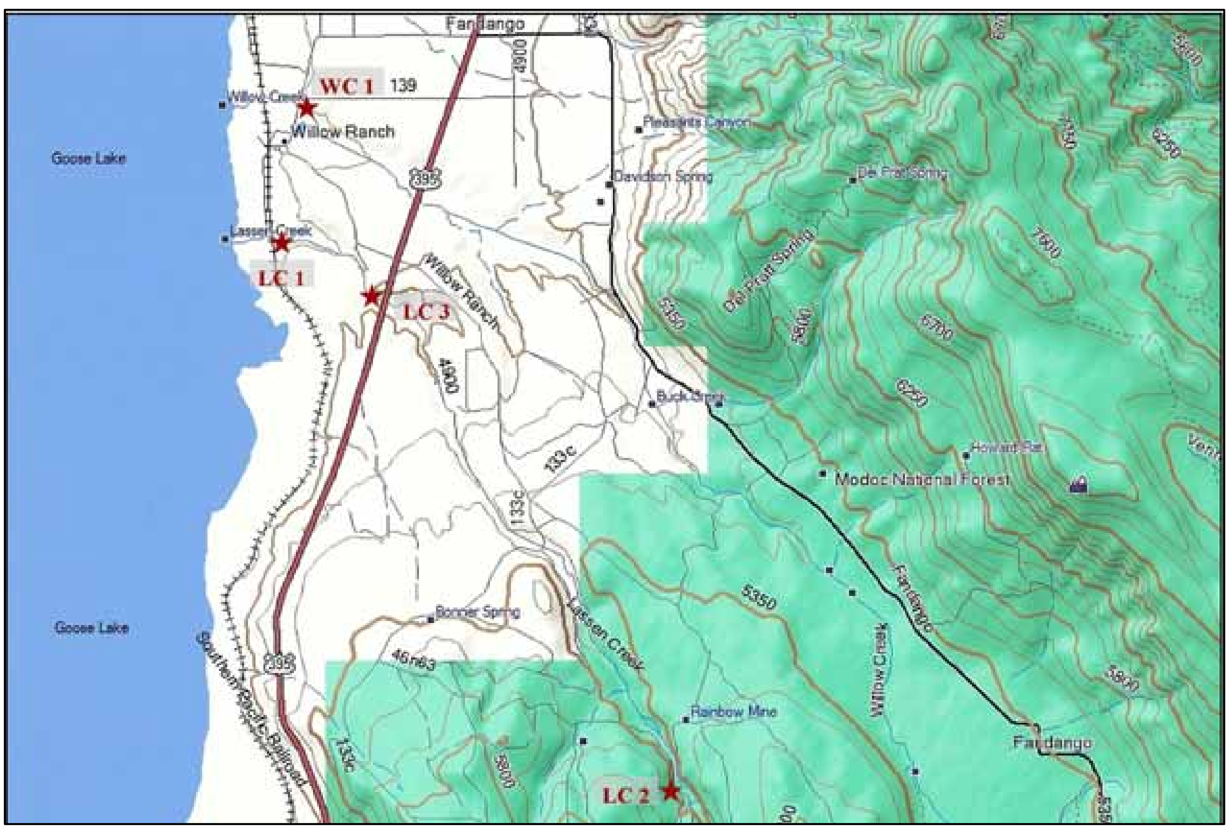


Table 5. Water temperature, dissolved oxygen, pH, conductivity, total dissolved solids, total organic carbon, turbidity and E.coli at Goose Lake Coalition monitoring sites in the 2007 irrigation season.

Sample Site	Date	Water Temp °C	DO mg/L	pH pH units	Conductivity µmhos/cm	TDS mg/L	TOC mg/L	Turbidity NTU	E.coli MPN/100 ml
WC 1	5/15/2007	14.7	37.61^	8.03	208	174	6.3	10.7	866*
	5/15/2007 Duplicate	14.8	38.75^	8.05	208	162	6.4	9.64	908*
	5/24/2007	--	--	--	--	--	--	--	--
	6/20/2007	18.0	10.06^	8.12	294	221	5.4	3.26	86
	6/20/2007 Duplicate	18.0	10.07^	8.13	295	222	5.4	3.54	76
LC 1	5/15/2007	9.7	27.74^	7.57	70	84	3.1	8.55	80
	5/24/2007	--	--	--	--	--	--	--	--
	6/20/2007	13.6	12.30^	7.48	102	105	3.6	5.72	222
	7/03/2007	12.9	3.90^	--	--	--	--	--	--
LC 2	6/20/2007	12.7	11.63^	7.72	60	66	1.6	3.29	219
LC 3	7/03/2007	13.6	4.05^	--	--	--	--	--	--

^ DO measurements were noted for potential errors in measurement and were discussed in the Coalition's December 2007 Semi-Annual Monitoring Report.

* E. coli levels at WC 1 on 5/15/07 exceeded the water quality standard of 235 MPN/100 ml.

Table 6. Summary of water column and substrate toxicity results from Goose Lake Coalition monitoring locations in 2007.

Sample Site	Date	*S. capricornutum* cells/mL (control)	*C. dubia* % survival (control)	*P. promelas* % survival (control)	*H. azteca* % survival (control)
WC 1	5/15/2007	2.080 (1.096)	100 (100)	95 (97.5)	98.8 (98.8)
	5/15/2007 Duplicate	2.054 (1.096)	0 (100)*	92.5 (97.5)	95 (98.8)
	5/24/2007	--	100 (100)	--	--
	6/20/2007	1.130 (0.423)	85 (100)	82.5 (100)	--
	6/20/2007 Duplicate	1.045 (0.423)	90 (100)	97.5 (100)	--
LC 1	5/15/2007	1.899 (1.096)	15 (100)*	97.5 (97.5)	95 (98.8)
	5/24/2007	--	20 (100)*	--	--
	5/24/2007 Duplicate	--	60 (100)*	--	--
	6/20/2007	1.012 (0.423)	40 (100)*	100 (100)	--
	7/03/2007	--	100 (100)	--	--
LC 2	6/20/2007	--	85(100)	--	--
LC 3	7/03/2007	--	100 (100)	--	--

*Results followed by an asterisk (*) were significantly toxic.

For all Lassen Creek samples that were significantly toxic to *C. dubia*, Toxicity Identification Evaluations (TIEs) were performed per the MRP requirements. In the 5/15 and 5/24 samples, the toxicity was not persistent and, therefore, the TIEs did not indicate what might have caused the toxicity. The analytical laboratory suggested that the condition causing the toxicity is either: 1) not stable in the water column so that it has already degraded beyond detection levels by the time a TIE is initiated, or 2) occurs at a level that is low enough to just begin having an effect on *C. dubia* survival allowing the potential chemical to quickly degrade to a level where it is no longer toxic to *C. dubia* and thus not have any affect on the insects during the TIEs.

Based on the lack of a known cause for the Lassen Creek *C. dubia* toxicity, the Coalition considered the possibility that natural, ambient water conditions might be causing the toxicity. The Coalition adopted a strategy to conduct additional monitoring and analyses that might confirm this theory or provide evidence to narrow down potential causes. Thus, during the third monitoring event on June 20, the LC 2 (Upper Lassen Creek) monitoring site was added to determine whether toxicity was present in the upper watershed. LC 2 is located in the Modoc National Forest near the creek's headwaters above where any irrigated agriculture impacts potentially take place. Significant toxicity was observed in the sample collected from LC 1 (40% survival), which is below the irrigated agriculture, but was not observed in the sample collected from the upper watershed at LC 2. The TIE results for the toxic LC 1 sample collected on 6/20 were not considered usable because the TIE control tests did not meet quality assurance criteria.

During the fourth monitoring event on July 3, the Coalition added the LC 3 (Mid Lassen Creek) site to determine whether toxicity was occurring lower in the watershed, but still above the influence of irrigated agriculture. In consultation with the CVRWQCB and Pacific EcoRisk, the Coalition developed a new strategy for this sampling event. Since samples from the LC 1 site had consistently caused reductions in *C. dubia* survival throughout the monitoring season, the Coalition asked the laboratory to immediately initiate a Phase 1 TIE on the LC 1 sample collected on 7/3/07 instead of first conducting the 96-hour regular toxicity test. Since previous results indicated that the toxicity was not persistent in the water samples long enough to be detected by the TIEs, the Coalition felt that this strategy of initiating an immediate TIE would increase the chances of obtaining meaningful results from the test. However, no information was gained from these tests because toxicity was not present in any of the samples.

In addition to the above steps initiated by the Coalition, a portion of the 5/24 water sample collected from LC1 was sent to an analytical laboratory to determine trace metals concentrations. Because there are no records of chemical applications, and pesticides have not been used in the Basin since 2003, the Coalition does not have any strong leads as to what may be causing *C. dubia* toxicity in Lassen Creek. During the 2007 season, follow-up sampling was conducted in Lassen Creek in an effort to narrow down possible causes of the toxicity.

The Coalition decided to have a metals analysis performed on the persistency sample collected on 5/24/07 to possibly eliminate metals as a cause for the toxicity observed in Lassen Creek. Because metals tend to be stable and not degrade, and the TIE results indicated that toxicity was not persistent in the original samples, this suggested that metals were not the cause of toxicity. However, the Coalition decided to have a metals analysis performed to verify that metals concentrations were too low to cause toxicity. The results of these tests are shown in Table 7. Further, the hardness of the LC 1 5/24/07 sample was 28 mg/L.

Table 7. Follow-up Metals Analysis to help determine the cause of *C. dubia* toxicity (hardness=28 mg/L)

Date	Site	Metal	AnalyticalMethod	Results	Units	Criterion	RL
5/24/07	LC 1	Arsenic	EPA 200.8	0.7	µg/L	10	0.5
5/24/07	LC 1	Boron	EPA 200.7	0.025*	µg/L	700	0.1
5/24/07	LC 1	Cadmium	EPA 200.8	ND	µg/L	0.91ϒ	0.1
5/24/07	LC 1	Copper	EPA 200.8	1.6	µg/L	3.1ϒ	0.5
5/24/07	LC 1	Lead	EPA 200.8	0.09*	µg/L	0.63ϒ	0.25
5/24/07	LC 1	Nickel	EPA 200.8	1.3	µg/L	18ϒ	0.5
5/24/07	LC 1	Selenium	EPA 200.8	ND	µg/L	5	2
5/24/07	LC 1	Zinc	EPA 200.8	5*	µg/L	41ϒ	10

* Results followed by an asterisk (*) denote values above the laboratory method detection limit but below the reporting limit. ϒ = Criteria are calculated using the California Toxics Rule hardness-based formulas for protection of freshwater aquatic life. The hardness of the LC 1 water sample collected on 5/24/07 was 28 mg/L.

As shown in Table 7, several metals were detected in the sample from LC 1. Pacific EcoRisk reported that they were all below the known thresholds for *C. dubia* toxicity. As expected, these analyses primarily served to cast doubt on the possibillity that metals are the primary cause of the *C. dubia* mortality in Lassen Creek. However, peer-reviewed studies show that *C. dubia* toxicity to metals is dependent on a variety of chemical factors, including alkalinity, pH, total organic carbon, and hardness. These factors affect the toxicity of each metal differently. Furthermore, there is evidence that combinations of metals can have synergistic effects on toxicity, suggesting that more investigation is warranted in order to determine if metals could be a factor in the reduced *C. dubia* survival exhibited in Lassen Creek. Further efforts to determine the cause and/or source of the *C. dubia* toxicity are described in the Special Projects Monitoring section of this plan.

2.5 Macroinvertebrate Sampling

During the 2007 irrigation season, the Goose Lake Coalition also obtained macroinvertebrate community composition data for key waterbodies through its partnership with UC Davis. As part of a larger macroinvertebrate study that the university is conducting, researcher Sabra Purdy (a UC Davis graduate student) collected macroinvertebrate samples in Lassen Creek. One of the specific stream reaches sampled included the area around the Coalition's LC 1 monitoring site where *C. dubia* toxicity was detected.

Analysis of the sample revealed 52.63% of the sample as EPT species, or Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies). These species are widely accepted as being the most sensitive to pollution, sedimentation, and temperature. In particular, the LC 1 macroinvertebrate sample showed good stonefly diversity, which is one of the most sensitive groups of invertebrates, needing excellent water quality to survive. Caddisfly diversity was also high. Overall, 16 out of the 34 genera within the 2007 sample had tolerance values of 3 or less (on a scale of 0 to 10, with 0 being the most intolerant of pollution and 10 being highly tolerant). Based on the Hilsenhoff Biotic Index, the sample rated 4.59, which corresponds to "good" water quality (again on a scale of 0 to 10, with lower numbers representing better water quality.) The upper limit for "very good" water quality is 4.5. Given the macroinvertebrate community composition observed in the Lassen Creek sample, the results support the assertion that no pesticide issues exist within the drainage. Overall, the diversity and sensitivity of the LC 1 sample was deemed to be excellent. The data from the 2007 macroinvertebrate sample at LC 1 and Sabra Purdy's narrative summary of the results are included with this MRPP as Appendix E.

Additional macroinvertebrate data from 2003 and the corresponding final report of another project conducted by UC Davis are included in Appendix F. In this study, researchers collaborated with 35 ranchers and numerous agencies to survey grazing management and macroinvertebrates across grazed and non-grazed meadow streams with the objective of identifying grazing strategies to enhance riparian health. Because of the Goose Lake Resource Conservation District's proactive collaboration on riparian grazing research, Lassen Creek was included in this study and aided in developing the understanding of how livestock distribution management can improve riparian health. The project's overall results show that common grazing management tools for improved livestock distribution (e.g. herding, salting, offstream water) can be implemented to improve and maintain riparian health. More specifically, the 2003 macroinvertebrate data for Lassen Creek are similar to the 2007 results. As shown in the Appendix, the percent of EPT species was again high, and Hilsenhoff Biotic Index rankings averaged 4.86 over three samples collected near LC 1.

III. PROPOSED MONITORING

As described in the following section, the Goose Lake Coalition has selected a subset of the full monitoring constituent list recommended in the MRP Order. Given that our past assessment monitoring efforts have shown no major exceedances, we do not have reason to suspect that significant water quality problems will arise. We will, however, continue to look for any major changes in management practices and/or pesticide use within the Basin that would warrant additional monitoring.

In the mean time, we have focused on a list of physical, chemical, and microbial parameters that past research has conclusively shown to be both 1) indicative of the types of water quality problems that can be associated with the grazing systems and hay production practices of our area, and 2) responsive to irrigation and grazing management practices common in the Goose Lake Basin. Any changes in pasture and/or irrigation management will be indicated by the set of water quality metrics we have proposed in the following strategy. Further, with the exceptions of *E. coli*, Total N, Total P, ammonia, and macroinvertebrate sample analysis, all of the parameters we have included in our strategy can be measured in the field with quality-calibrated meters. This helps to not only control laboratory costs, but also provide real time data to guide on-the-ground management practices throughout the irrigation season.

The following sections of this plan describe the Coalition's Core Monitoring, Assessment Monitoring, and Special Project Monitoring strategies. Based on the MRP requirements, the annual schedule will be as follows, with the repeating 3-year cycle beginning in 2012:

Site	2009	2010	2011	2012
Lassen Creek	Core, Special Project, if needed	Core, Special Project, if needed	Assessment, Special Project, if needed	Etc.

3.1 Core Monitoring

The Coalition's Core monitoring strategy has been designed to describe water quality trends within the Goose Lake Basin. Though past monitoring efforts (as described in Part II of this plan) have revealed no major water quality issues, the monitoring sites, sampling frequency and parameters to be analyzed will help us address Program Question #5, as listed in the MRP Order, by giving us the necessary information to determine if water quality conditions in waters of the State within our Coalition boundaries are getting better or worse through implementation of management practices identified through the ILRP as well as other watershed improvement efforts by the GLRCD and Goose Lake Fishes Working Group and Watershed Council.

Sampling location and description: Core monitoring, as well as Special Project Monitoring if it is still needed, will be conducted each year at the Coalition's Lower Lassen Creek (LC 1) monitoring site, beginning in 2009. The GIS coordinates for LC 1 are +41° 53.494 N and -120° 21.562 W.

The Lassen Creek watershed is approximately 14 miles long, with the upper reaches falling within the boundary of the Modoc National Forest at elevations reaching nearly 7,500 feet. Moving down from the mountains, Lassen Creek stair steps its way to Goose Lake through a series of small mountain meadows and steep canyons. Stream flow in Lassen Creek is generated by snowmelt in the higher elevations of the watershed, with peak runoff occurring in the spring (April until mid-May). By the end of July, stream flow is significantly diminished and is primarily spring-fed other than occasional rainstorm events during this base flow period. Stream flow is diverted into open irrigation delivery ditches usually starting in April or May and ending in July or August, depending on the annual snowpack conditions and stream-flow levels.

The LC 1 site is located below all irrigated agriculture activities in the Lassen Creek drainage. The site is below Highway 395 but immediately above where the railroad crosses the creek. Directly upstream of the sampling site are irrigated meadows used for both hay production and livestock grazing. The sampling site is near a traditional crossing site where ranch vehicles and hay equipment move across the stream channel. All samples have been and will continue to be collected above the crossing to avoid any influence of the crossing in our results. Figure 2 shows upstream and downstream views from LC 1. In the upstream photo, the creek appears fairly wide near the bottom of the frame because of the stream crossing. The yellow arrow indicates the approximate location of where samples will be collected. In the downstream photo, the railroad trestle is visible.

Figure 2. Lower Lassen Creek sampling site (LC 1), facing upstream (left) and downstream (right).

Monitoring season: The monitoring season will consist of one snowmelt event that takes place prior to the irrigation season, followed by monthly sampling as long as the irrigation season continues. Corresponding to the annual runoff patterns described above, this will mean that in most years, the snowmelt sample will be collected in April, with irrigation season sampling occurring from May through July or August, depending on snowpack conditions. Once the irrigation season has ended, the Coalition will perform one additional sampling event in the fall between late September and November, once stream flow increases after the summer base flow period. The Coalition will make every attempt to schedule the fall sampling event following a rain event.

Monitoring parameters: With the exception of *E. coli* and ammonia, the Coalition will focus on monitoring field-based constituents using quality calibrated meters. The parameters to be monitored, their purposes, and the means for determining their values are summarized in Table 8. In addition to the constituents listed, we will take digital photographs of each site during every sampling event to document site conditions.

Table 8. Core monitoring constituents and collection/determination methods.

Constituent	Purpose	Collection & Determination
Instantaneous Streamflow	Constituent of concern for aquatic habitat degradation. Required in conjunction with constituent concentrations to determine instantaneous constituent load.	Calculated via USGS area-velocity method from in field measurements of stream water width, depth, and velocity along a cross-section at each sample site on each sample collection event. Velocity measurements will be collected using a Marsh-McBirney Flo-Mate Model 2000 Portable Flow Meter.
pH	General water quality constituent.	Measured in the field with a calibrated pH/EC meter (YSI 63).
Electrical Conductivity	General water quality constituent.	Measured in the field with a calibrated pH/EC meter (YSI 63).
Dissolved Oxygen	Constituent of concern for aquatic habitat degradation.	Measured with calibrated dissolved oxygen meter (YSI 550A).
Water Temperature	Constituent of concern for aquatic habitat degradation.	Measured with calibrated dissolved oxygen meter (YSI 550A).
Turbidity	Constituent of concern for aquatic habitat degradation.	Measured with calibrated turbidity meter (Orbeco-Hellige Portable Turbidimeter Model 966).
Commensal *E. coli*	Constituent of concern for drinking water quality.	Grab sample; laboratory analysis.
Total Ammonia	Constituent of concern for aquatic habitat degradation.	Grab sample; laboratory analysis.

3.2 Assessment Monitoring

The Coalition's Assessment monitoring strategy is designed to continue to describe the water quality conditions within the Basin as well as contribute to our understanding of long-term water quality trends. As evidenced by the information included in this plan, much is known about the geologic and hydrologic conditions of the Basin as well as the types of agricultural practices utilized by growers. Given the small size of the Basin, the relatively few number of growers compared to other areas within the Central Valley, and the emphasis on only a few predominant crop types grown, the Coalition has a good grasp of the activities related to irrigated agriculture and any changes that might take place. Further, the past research activities by the CVRWQCB and UC Davis have provided a substantial base of information that has allowed the Coalition to characterize existing water quality conditions and determine that they are generally protective of beneficial uses.

Thus, in terms of addressing MRP Order R5-2008-0005 Program Question #1, the Coalition already has an extensive foundation of information to be able to determine that there are few known water quality issues. The Assessment monitoring strategy described here, however, will allow the Coalition to detect any water quality issues if they arise. Relative to Program Question #2, the information gathered by this Assessment monitoring strategy and Special Project Monitoring will also help determine the magnitude and extent of any problems that may develop. This will aid in the development of any needed site-specific monitoring and the preparation of management plans, just as previous Assessment monitoring in 2007 has led to the development of the Lassen Creek Management Plan and source study described in section 3.3.

Sampling Frequency and Location: Assessment monitoring will be conducted every third year, beginning in 2011. Monitoring will again occur at the Lower Lassen Creek (LC 1) site, as described and pictured above.

Monitoring Season: The season for Assessment monitoring will mirror that of Core monitoring, with one event during the snowmelt/pre-irrigation season, monthly sampling during irrigation, and an additional event in the fall following a rain event if possible.

Monitoring Parameters: Assessment monitoring will include all of the water quality parameters listed for Core monitoring in Table 8 plus additional parameters to help examine trends, assess the effectiveness of management practice implementation, and guide future monitoring. The parameters included in our Assessment monitoring strategy are included in Table 9.

Table 9. Assessment monitoring constituents and collection/determination methods.

Constituent	Purpose	Collection & Determination
All core monitoring constituents (Instantaneous streamflow, pH, electrical conductivity, dissolved oxygen, water temperature, turbidity, commensal *E. coli* and total ammonia)	General water quality constituents, constituents of concern for aquatic habitat degradation, and constituent of concern for drinking water quality (*E. coli*).	Measured in the field with calibrated meters; grab sample for laboratory analysis (*E. coli* and ammonia).
Total N	Constituent of concern for aquatic habitat degradation.	Grab sample; laboratory analysis
Total P	Constituent of concern for aquatic habitat degradation.	Grab sample; laboratory analysis
Macroinvertebrate Community Composition	Constituent of concern for aquatic habitat degradation.	Collected in field using standard CDFG California Stream Bioassessment Protocol; laboratory analysis

Additionally, the Coalition will monitor any changes in agriculture practices (based on information submitted by Coalition members) and pesticide use (using pesticide use reports from the Agricultural Commissioner) within the Basin annually and report any changes in the Annual Monitoring Report (AMR). If there is a change in any agriculture practice, or if there is reported pesticide use, the Regional Board will be notified so that the need for additional monitoring can be evaluated.

3.3 Special Project Monitoring to Determine Cause of the *Ceriodaphnia dubia* toxicity

Given the past Assessment monitoring that has been conducted in the Goose Lake Basin, an extensive body of knowledge exists regarding the conditions of the waters of the State within the area. During the 2007 ILRP monitoring, however, a gap in the knowledge base was identified when *C.dubia* toxicity was detected in Lassen Creek. Without any readily identifiable sources or causes of the toxicity, the Coalition worked with the CVRWQCB to develop the Lassen Creek Management Plan (LCMP), as described in this section, to be a targeted, site-specific study that will hopefully help us identify the source of the problem while also determining its magnitude and extent. Through the implementation of the LCMP, the Coalition will be able to address Program Question #3 in determining the possible contributing source(s) from irrigation agriculture to the *C. dubia* issue, which is the main water quality issue identified in the Basin to date. In the future, if other water quality problems are detected through the Coalition's Assessment and Core monitoring, similar Special Project monitoring plans will be developed to help us estimate the relative importance of agriculture's contribution to the problem and determine management practices to alleviate the issue.

Problem: As described in Section 2.4, the Coalition's 2007 ILRP monitoring detected *C. dubia* toxicity multiple times at the same location in Lassen Creek, thus triggering the requirement for the Coalition to develop a management plan. Because follow-up testing in the form of TIEs were largely inconclusive, the Coalition was left without many leads as to what could be causing the water flea toxicity. Thus, the Coalition worked with the CVRWQCB to develop the LCMP, which describes what is known about the Lassen Creek watershed and outlines the design for a source study to be conducted throughout the 2008 monitoring season to help determine the source of the toxicity. The complete LCMP is included with this MRPP as Appendix G. Though the Coalition is hopeful that the *C. dubia* toxicity issue will be resolved through the 2008 sampling effort, the LCMP is included here because all of the results from the source study will not be available when this MRPP is submitted for approval. Further, it is important to note that the outcomes of the LCMP will also help determine what type (if any) special projects monitoring will be needed in the future.

Study design: To help determine the source of the *C. dubia* toxicity, two primary monitoring sites are being utilized in the LCMP. Both locations were monitored by the Goose Lake Coalition in 2007 and are thus known as "Lower Lassen Creek (LC 1)" and "Mid Lassen Creek (LC 3)". Since LC 3 is located immediately above any irrigated agriculture activities and LC 1 lies below all irrigation, these two sites essentially bracket the portion of the Lassen Creek watershed that is affected by irrigated agriculture and provide an "above and below" perspective for this study design.

Monitoring parameters: Given the results from the 2007 irrigation monitoring season, the information gleaned from the laboratory analyses of the *C. dubia* toxicity samples, a preliminary review of *C. dubia* literature, and the results of previous water quality monitoring efforts, we have designed the source study to capture the differences in several parameters that will help determine when, why, and where the toxicity problem is occurring, including: stream flow, irrigation and diversion, location, and variation in natural water characteristics.

In order to assess these parameters, several different types of monitoring are being conducted. First, the Coalition will again conduct the 96-hour *C. dubia* toxicity tests, as were conducted in 2007. At the same time the toxicity monitoring is being conducted, we are also sampling for a select set of chemical and metals, including cadmium, copper, lead, zinc, calcium, magnesium, sodium, potassium, carbonate, bicarbonate, chloride, sulphate, and fluoride. Samples will also go through an Unidentified Peaks Analysis, followed by specific chemical tests if peaks are detected. Because these tests will provide a greater level of detail than Phase 1 TIE tests, the chemical tests will be performed in lieu of conducting any TIEs if/when *C. dubia* toxicity is detected.

In addition to the toxicity and chemical tests, we are also conducting bi-monthly sampling of some general water quality constituents, including stream flow, temperature, dissolved oxygen, electrical conductivity, pH, total suspended solids, and turbidity. The more frequent sampling will not only help us determine any seasonal or flow-related changes in water chemistry, but will also allow us to detect if changes in any of these parameters might reach levels that are known to affect *C. dubia* survival. Other constituents to be sampled on roughly a monthly basis (when toxicity and chemical tests are performed) include total dissolved solids, total organic carbon, *E. coli*, alkalinity, hardness, and dissolved organic carbon. Lastly, through the Coalition's partnership with UC Davis, macroinvertebrate sampling will again be conducted this season.

Schedule and Results to Date: The source study was initiated during the early spring snowmelt/runoff season in April 2008. The snowmelt monitoring event served to document water quality conditions and the presence or absence of the *C. dubia* toxicity *before* the irrigation season began. Interestingly, the laboratory analysis of the pre-irrigation samples at both LC 1 and LC 3 showed no significant *C. dubia* toxicity.

After the initial "pre-irrigation" sampling had been conducted during the snowmelt period, the Coalition then began regular irrigation season monitoring, with the first event occurring in early June 2008. Results from this event showed significant toxicity at both LC 1 and LC 3. The *C. dubia* survival rates at LC 1 were 65% and 75% (a field duplicate sample was collected) and were 35% at LC 3. Given that the toxicity was detected above all irrigated agriculture activities at LC 3 as well as below at LC 1, the Coalition scheduled a conference call with CVRWQCB staff and other project advisors to discuss the results and determine the next steps of carrying out the LCMP. During the call, all parties agreed that the Coalition should conduct another irrigation season monitoring event to see if the toxicity results observed in June would be consistent. Accordingly, the Coalition sampled all monitoring parameters in early July. As seen in June, results from the July event showed significant toxicity at both LC 1 and LC 3. This time, the *C. dubia* survival rates at LC 1 were 25% and 20%, and were 25% at LC 3. At the time this MRPP was submitted, another conference call between the Coalition and the CVRWQCB had been scheduled for the end of July to discuss these additional results and their implications for the remainder of the 2008 monitoring season and *C. dubia* toxicity source study.

Once the 2008 irrigation season has concluded and all data and lab analyses are available, the Coalition will convene the project's advisory group to discuss the monitoring results and the conclusions that can be drawn from the season's outcomes. We will do a full analysis of the existing *C. dubia* literature as well as the previous water quality monitoring data available for Lassen Creek at this time, within the context of helping us interpret and understand the results of the 2008 monitoring season. All results and analysis will be provided in a management plan report to be submitted by 15 November 2008. Based on the monitoring results and the discussion of the advisory group, we will determine if additional information is needed or a continued source study is warranted.

3.4 Rationale for Modifications from CVRWQCB MRPP Order No. R5-2008-0005

As is evident by the above description of the Coalition's monitoring strategy, we have proposed several modifications from the MRP order. We have based these modifications on multiple factors, including: 1) the type and schedule of irrigated agriculture activities within the Goose Lake Basin, 2) the DPR pesticide use information available for the area, 3) previous water quality information collected through the Coalition's ILRP monitoring efforts in 2007 and thus far in 2008, 4) published research relevant to the Basin and the type of agriculture that occurs here, and 5) the need to utilize our limited available resources (in terms of both time and funding) towards the implementation of on-the-ground watershed improvement projects and management practice implementation. Accordingly, in the following section, we address each major modification to the MRP order that we have proposed in the monitoring strategy and give our rationale for the changes.

Selection of monitoring sites: As shown in Table 1, the types of crops, agricultural uses, and sources of irrigation within the Goose Lake Basin are very similar throughout the watershed. Accordingly, the management practices utilized by growers are also very consistent within the Coalition's boundaries. These strong similarities make it possible to select one primary monitoring site, LC 1, as being representative of the water quality conditions and the management practices employed throughout the Basin.

The only major difference in agricultural practices between Lassen Creek and most of the other waterbodies influenced by agriculture within the Basin is that surface water diversions are the sole means of irrigation within the Lassen Creek drainage. No groundwater is utilized for agriculture within the Lassen watershed. As noted in Table 1, no tailwater is generated by the low pressure groundwater irrigation systems used in the other watersheds within the Basin (with the exception of Willow Creek, where surface water diversions are also the only means of irrigation). Thus, Lassen Creek and Willow Creek are the only two waterbodies to receive irrigation return flows as surface runoff in ditches and shallow swales.

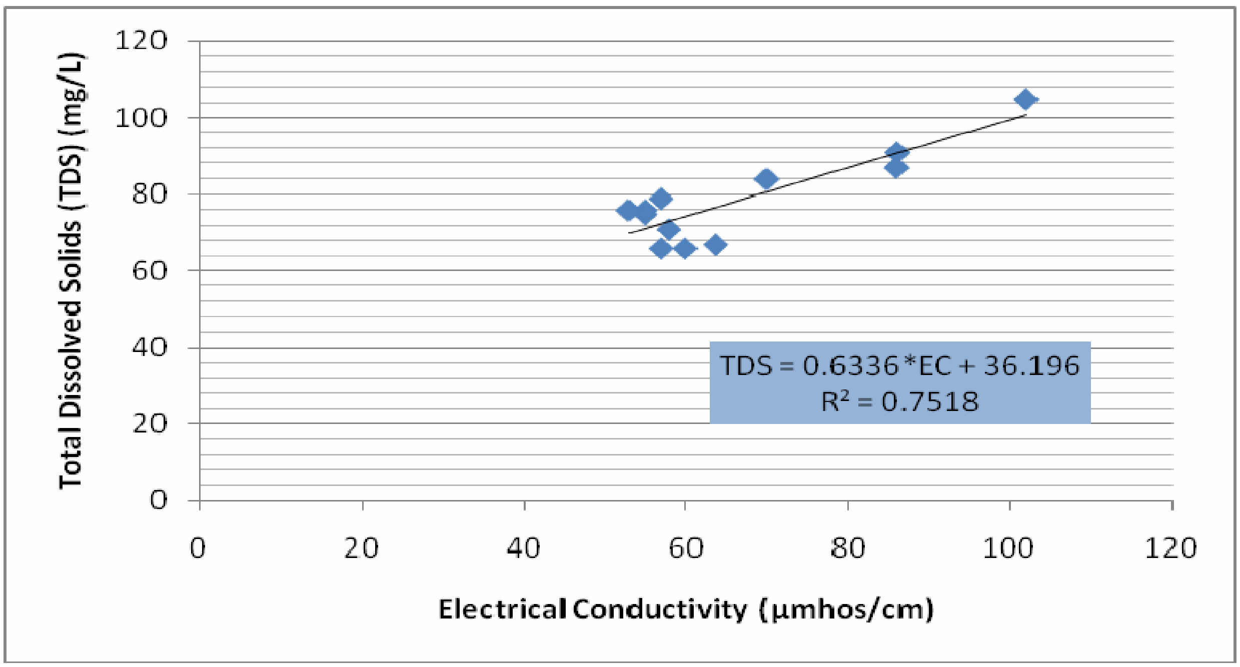
In examining the Lassen and Willow creek watersheds, the strong similarities that exist in geology, hydrology, agricultural operations, and water quality between these two watersheds are evident. Thus, there are enough similarities for Lassen Creek to be considered representative of Willow Creek as the only other stream within the California portion of the Basin to receive surface irrigation return flows. Further, given the consistent types of agriculture, irrigation, and management practices throughout the Basin, there are sufficient similarities for Lassen Creek to also be considered representative of the Coalition's area as a whole. The LC 1 monitoring site allows the Coalition to examine water quality trends across years as well as seasonally within years, using the strong foundation of existing monitoring information to assess any changes that may take place.

Modification of Sample Frequency: As evidenced by Table 2, there is a defined portion of the year when activities related to irrigated agriculture take place in the Goose Lake Basin. Much of this is due to the short growing season of the Basin and the occurrence of cold, snowy winters. Further, the types of crops grown do not require any type of dormant season spraying of herbicides or pesticides, use of irrigation water to prevent frost damage, application of fertilizer, or other non-growing season practices. In the winter, any type of tillage or other ground preparation is infeasible due to the snow cover and often frozen ground. Further, the creeks themselves can freeze over, which would preclude safe and representative sample collection. Thus, sampling during the winter months is not feasible or meaningful. For these reasons, the Coalition has proposed to sample during the portion of the year when activities related to irrigated agriculture are taking place (roughly April through September) and when it is safe for the sampling crew to perform the monitoring instead of conducting monthly sampling for the entire year, as identified in the MRP Order.

Modifications of Core & Assessment Monitoring Constituent Lists:

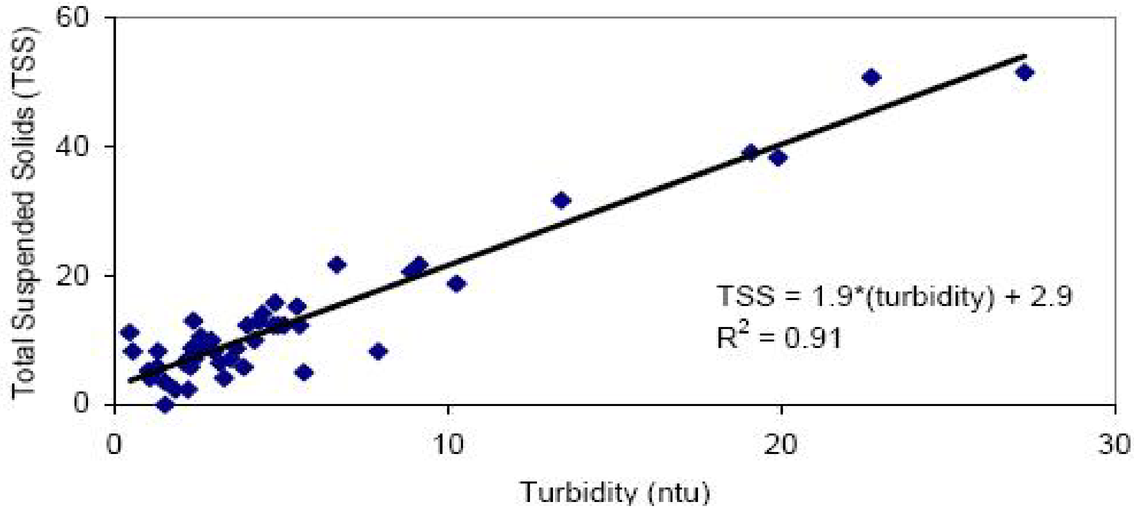
Total Dissolved Solids: The Coalition proposes to utilize electrical conductivity measurements (taken with an YSI Model 63 Handheld pH, Conductivity, Salinity, and Temperature System) as a surrogate for total dissolved solids (TDS). The electrical conductivity of water is directly related to the concentration of dissolved ionized solids in the water. The ions create the ability for that water to conduct an electrical current, which can be measured with the YSI 63 meter. When correlated with laboratory TDS measurements, electrical conductivity provides an approximate value for the TDS concentration, usually to within ten percent accuracy. Though the correlation between electrical conductivity and TDS is strong, the specific relationship between the two parameters is also very site specific. Thus, utilizing the data collected during the Coalition's 2007 and 2008 monitoring seasons to date, Figure 5 shows the specific relationship between electrical conductivity and TDS in Lassen Creek. As electrical conductivity increases, so does TDS concentration. Data from future monitoring events will be added to this graph to further refine this relationship.

Figure 5. Correlation between electrical conductivity and total dissolved solids for Lassen Creek monitoring locations.



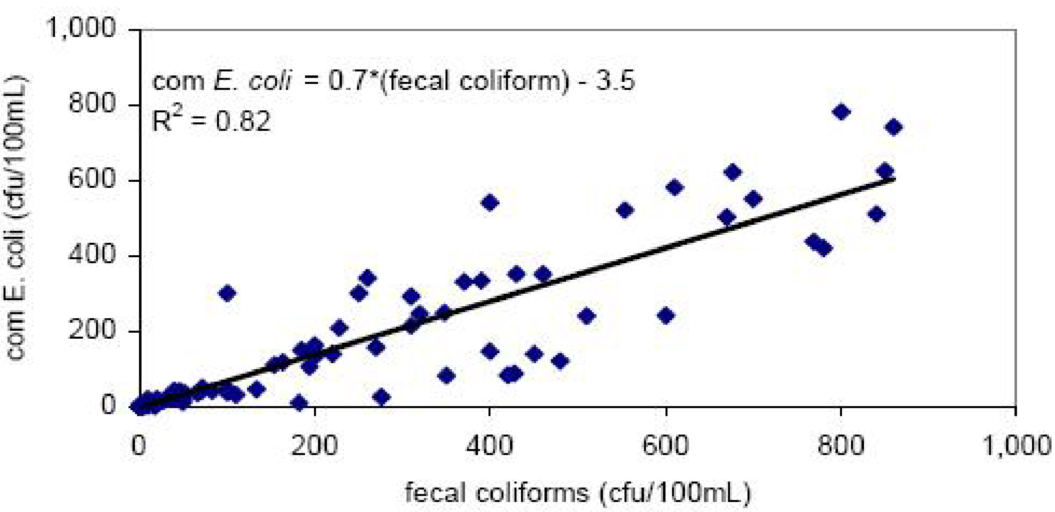
Total Suspended Solids: The Coalition proposes to utilize turbidity measurements (taken with an Orbeco-Hellige Portable Turbidimeter Model 966) to indirectly estimate total suspended solids (TSS). Data from other parts of the region with similar meadow systems and agricultural practices demonstrates the strong correlation that exists between turbidity and TSS, indicating that turbidity can be utilized as a surrogate for TSS. Figure 6 shows the correlation established by the Upper Feather River Watershed (UFRW) group based on their monitoring in Sierra Valley, Indian Valley, and American Valley during 2006 and 2007. As the level of suspended solids (e.g. particulate organic matter and sediments greater than or equal to 0.45 µm in size) and dissolved solids (e.g. dissolved organic carbon less than 0.45 µm in size) increases, so does the turbidity of the sample.

Figure 6. Correlation between turbidity and total suspended solids for UFRW monitoring.



Fecal coliforms: The USEPA recommends commensal (i.e. non-pathogenic, non-disease-producing) *E. coli* as the most appropriate indicator of fecal derived microbial pollutions. While the Goose Lake Coalition has baseline commensal *E. coli* data for the Basin (including the LC 1 monitoring site), fecal coliform concentration has not been measured to date. A research effort at the University of California-- Davis (UCD) led by Dr. Ken Tate has been simultaneously analyzing commensal *E. coli* and fecal coliform samples collected in Sierra Valley and other mountain meadow irrigated pasture systems in the central and northern Sierra Nevada region for several years. Figure 7 illustrates the high correlation UCD has found to exist between commensal *E. coli* and fecal coliforms in streams flowing through these systems, indicating that the same relative information is provided from commensal *E. coli* as compared to fecal coliforms. Thus, we propose to not include fecal coliforms in our Core or Assessment monitoring due to the lack of baseline data on fecal coliforms, the superiority of commensal *E. coli* as an indicator of microbial pollution, and the redundancy of monitoring both commensal *E. coli* and fecal coliforms.

Figure 7. Correlation between commensal *E. coli* and fecal coliforms for central and northern Sierra Nevada grazed meadow stream systems during the 2007 irrigation season. Source: K.W. Tate, UCD



Pesticides and Metals: Use of agricultural pesticides has not occurred within the Goose Lake Basin since 2003, as previously described in Section 1.2 (Pesticide Use) and shown in Table 3. Further, we are aware of no application of metals associated with any of the agricultural practices conducted within the Basin. Metals analysis performed by the CVRWQCB in the 1990's (see Appendix A) and by the Goose Lake Coalition in 2007 revealed no metals near levels of concern. Further, in 2007, the Coalition conducted all required toxicity tests on both Lassen and Willow creeks. As summarized in Table 6, the results showed no other toxicity issues other than *C. dubia* in Lassen Creek, which is being addressed under the Lassen Creek Management Plan (LCMP). The *C. dubia* toxicity results are thought to be an anomaly, because the natural conditions of the Basin's waters are such to make the test invalid (Hyne et al. 2005; Cowgill and Milazzo 1991). The LCMP source study will, however, help confirm that there are no toxicity problems related to impacts from irrigated agriculture.

In addition to the metals and toxicity analyses that have been conducted in the Basin, macroinvertebrate sampling has also been performed, most recently in 2003 and 2007. As summarized in Section 2.5 of this plan and shown in Appendices E and F, the samples showed no evidence that macroinvertebrates in Lassen Creek have been degraded. Based on the taxa present, the 2007 samples from LC 1 were determined to have excellent diversity and sensitivity. Though there is no quantitative standard for aquatic macroinvertebrate metrics, the results of these sampling efforts do not suggest an impairment of the aquatic macroinvertebrate community.

Thus, these results do not justify the continuation of toxicity monitoring (with the exception of *C. dubia* toxicity testing as part of the LCMP) within the Goose Lake Basin as part of either Core or Assessment monitoring. In the place of toxicity testing, the Coalition will continue to perform macroinvertebrate sampling as part of our Assessment monitoring routine. Given the baseline macroinvertebrate information available and the fact that macroinvertebrates are sensitive to chemicals and to habitat change, the continued collection of this bioassessment information will allow us to: 1) characterize trends, 2) confirm the health of these systems, 3) measure current biological conditions, and 4) evaluate any improvements through BMP implementation and the benefits thereof. If water quality problems are detected during monitoring, the macroinvertebrate sampling may also help with characterization of the impairment and its diagnosis. If it is feasible to continue coordinating macroinvertebrate sampling with UC Davis as part of larger research projects the university is conducting, the Coalition will utilize their expertise to obtain these analyses. If this type of coordination becomes infeasible at any point, the Coalition will perform the macroinvertebrate sampling and will ensure accurate sample analyses are obtained.

Further, the Coalition will annually monitor changes in agricultural practices and pesticide use within the Goose Lake Basin. If there is a change in agricultural practices that utilize pesticide or metal applications, the Regional Board will be notified so that the need for additional monitoring can be evaluated.

Hardness: One of the primary uses of water hardness data is to help determine the bioavailability (i.e. toxicity) of any metals present within the water sample. As described above, past metals analyses performed in the Goose Lake Basin revealed no metals near levels of concern, leading the Coalition to propose to discontinue metals sampling under this MRPP unless changes in agricultural practices warrant re-instating these analyses. Thus, because the Coalition will not be monitoring for metals, hardness data would have limited significance since it will not be used to help determine detrimental levels of metals.

Total Organic Carbon: The analysis of total organic carbon (TOC) is well recognized as a means to measure water quality for drinking water purposes. Additionally, TOC analysis of sediment samples can help evaluate the expected magnitude of any detected sediment toxicity to the test species.

The recognized beneficial uses of Goose Lake do not include being a source of drinking water. Therefore, the tributaries to Goose Lake are also not considered drinking water sources. Thus, the measurement of TOC to evaluate drinking water quality is not relevant to the Coalition. Further, under this new MRPP, the Coalition will eliminate sediment toxicity testing (as described above), so the information provided by TOC analysis in regards to the magnitude of toxicity is also not relevant to us. For these reasons, we proposed to eliminate TOC as a parameter to be analyzed under this plan.

Nutrients: As described in the agricultural practices summary of this plan (Section 1.2), the use of fertilizers is very limited within the Goose Lake Basin. Existing data in published research indicate that these systems are inherently low in nutrients to the point of actually being deficient in many cases. Often, pasture and meadow systems such as those in the Goose Lake Basin serve as sinks, as nutrients are sequestered by vegetation and soil (Tate et al. 2005c). As shown in Table 4, very low levels of nitrogen and phosphorus were observed in Lassen and Willow creeks at monitoring sites below all irrigation activity. For instance, Table 4 shows that levels of nitrate and ammonium in both systems were only slightly above detection limits and thus well below those of water quality concern for both drinking water and stream eutrophication. Additionally, the past irrigated agriculture discharge study conducted by UC Davis in 2003 (see Appendix D) showed that electrical conductivity is correlated to some dissolved pollutants. As the level of some dissolved pollutants (SO_4 and K) increases, so does electrical conductivity. Since the Coalition will be measuring electrical conductivity as part of our Core and Assessment monitoring, a significant increases or increasing trends in electrical conductivity will indicate the need to further investigate a possible increase in nutrients.

Based on the relationship in Lassen Creek between electrical conductivity and TDS portrayed in Figure 5, it appears that a 30% increase in electrical conductivity could result in a significant increase in TDS. For example, if electrical conductivity is 50 µmhos/cm, then a 30% increase would be 65 µmhos/cm. The TDS would then change from approximately 68 mg/L to 80 mg/L based on the correlation between these two parameters. Currently, there are limited data points on the graph of Figure 5, and there is quite a bit of variation in TDS over a narrow range of conductivity (e.g. an electrical conductivity of 55-60 µmhos/com results in a TDS value ranging from 66-80mg/L). As more data points are added to the correlation between electrical conductivity and TDS for Lassen Creek, this variability should decrease. In the mean time, however, given the existing natural variability in the relationship, we suggest that the 30% increase in electrical conductivity would have to be sustained throughout the monitoring season (instead of being observed in one monitoring event only) in order to be considered significant. Another important aspect of using electrical conductivity to indicate possible increases in nutrients will be to examine the monitoring results for a slower (less than 30%) but steady increase in electrical conductivity over several years of sampling. Though the annual increase in electrical conductivity may be relatively small, the increase over time (i.e. 2-3 years) may be cumulatively significant. Lastly, it is important to note that past research has shown that as flow decreases in these systems, electrical conductivity increases, due to concentration of the existing load (Tate et al. 2005c). This relationship will also be taken into account as electrical conductivity data is interpreted and evaluated. Over time, as more data is collected, we will be able to refine our estimate as to what a significant increase in electrical conductivity is that suggests a significant increase in nutrients warranting additional monitoring.

In summary, given the low nutrient values observed below agricultural areas, the ability of pastures and meadows to act as nutrient sinks, the limited agricultural use of fertilizers within the Goose Lake Basin, and the correlation between some dissolved pollutants and electrical conductivity, it is unwarranted to include all of the suggested nutrient analyses within our Core monitoring program. Upon recommendation by the CVRWQCB, however, screening level ammonia tests will be included in the Core monitoring program. Additionally, we will measure Total N, ammonia, and Total P during our Assessment monitoring to track changes over time and ensure that future activities or management do not increase nutrient levels. If Total N, ammonia, Total P, or electrical conductivity exhibit a significant increase or an increasing trend, we will then evaluate the various species of the nutrients (e.g. nitrate, nitrite, etc.) to evaluate the cause of the increase. We have no reason to believe that these values will significantly increase, but if they do, we will determine the cause and source.

IV. REPORTING

4.1 Monitoring Results: Monitoring results will be submitted to the CVRWQCB in Quarterly Monitoring Data Reports. The first report will cover from 1 January through 31 March and will be submitted by 1 June. The second report will cover 1 April through 30 June and will be submitted by 1 September. The third report will cover from 1 July through 30 September and will be submitted by 1 December. If no monitoring occurs during a given period, the associated quarterly data report will state that no monitoring occurred (as consistent with the Coalition's MRPP). The data reports will include electronic data submittal in SWAMP comparable format as well as copies of all field, laboratory, and quality control reports as specified in the MRP Order.

Further, as described in the MRP Order, the Coalition will submit an annual report by 1 March each year that covers all monitoring from the previous calendar year. The Coalition will include all elements described in the MRP Order, including electronic data submitted in SWAMP comparable format. In addition to the tabulated results of all analyses as submitted in the data reports, the annual report will include: a complete discussion of the monitoring results, updates on pesticide use or changes in agricultural practices, conclusions and recommendations that can be drawn from the current year's efforts, and any actions taken to address water quality exceedances. The Coalition will also include updates on outreach efforts to Basin growers as well as the progress made in the identification and implementation of management practices within the watershed. All information will be presented in a way that compliance with the Conditional Waiver is readily discernible.

4.2 Other Reports: The Coalition will utilize field data and lab analysis results to determine if any water quality exceedances have occurred. If water quality objectives have been exceeded, we will submit an Exceedance Report to the CVRWQCB Coalition liaison via e-mail or fax that describes the exceedance, needed follow-up monitoring, and analysis or other actions the Coalition Group plans to take to address the exceedance. If more than one exceedance of any water quality standard occurs at the same site or within the area that the site represents within any three-year period (or if requested by the CVRWQCB Executive Officer), the Coalition will prepare a Management Plan to address the problem.

V. QUALITY ASSURANCE PROJECT PLAN (QAPP)

The Quality Assurance Project Plan (QAPP) for the Goose Lake Agricultural Water Quality Program is included as Appendix H of this MRPP. The QAPP discusses the details of how samples are collected and analyzed to provide data that is representative of the Basin and is scientifically valid and defensible.

VI. REFERENCES

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APPENDIX A

Central Valley Regional Water Quality Control Board's

Water Quality Monitoring Report:

Lassen Creek, Willow Creek and Goose Lake

1993-1996 and 1997-1998 Addendum

APPENDIX B

UC Davis Intensive Stream Temperature Monitoring Study—Part A:

"Graphical analysis facilitates evaluation of stream-temperature monitoring data"

APPENDIX C

UC Davis Intensive Stream Temperature Monitoring Study—Part B:

"Statistical analysis of monitoring data aids in prediction of stream temperature"

APPENDIX D

UC Davis Irrigated Agriculture Discharge Study:

"Monitoring helps reduce water-quality impacts in flood-irrigated pasture"

APPENDIX E

UC Davis 2007 Macroinvertebrate Data

APPENDIX F

UC Davis 2003 Macroinvertebrate Data & Project Summary

APPENDIX G

Lassen Creek Management Plan (LCMP) for *Ceriodaphnia dubia* Toxicity

APPENDIX H

Goose Lake Agricultural Water Quality Program Quality Assurance Project Plan (QAPP)